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(54) **Surveillance systems.**

(57) A surveillance system has an image pick-up sensor (1), an image processing unit (30) connected to the image pick-up sensor (1) for detecting a scene change of a video signal obtained from the image pick-up sensor, an alarm generator (13, 24) connected to the image processing unit (30) for generating an alarm signal upon detection of a scene change, and a self-tester including a noise signal generator (27) and means (23) for superimposing a noise signal from the generator (27) on the video signal to be supplied to the image processing unit (30) as quasi-scene change information.

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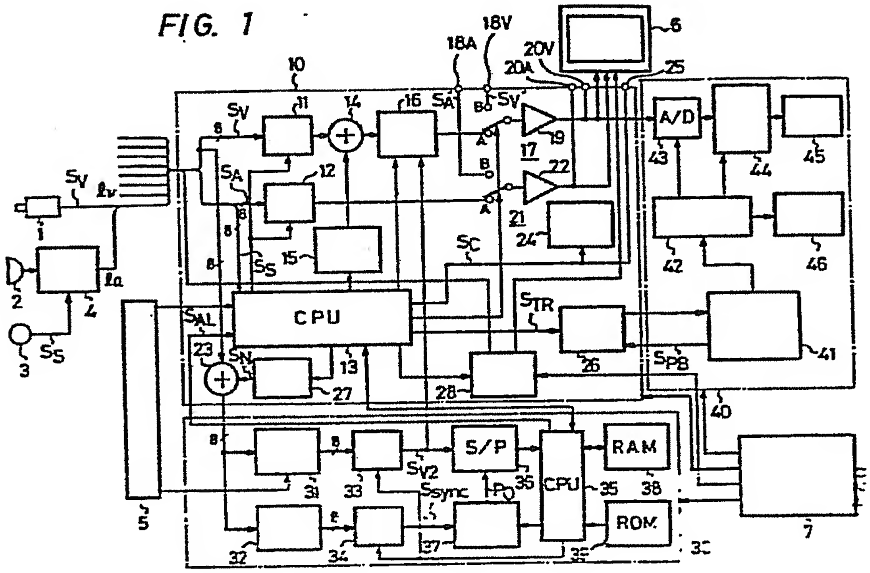
Croydon Printing Company Ltd

FIG. 1



SURVEILLANCE SYSTEMS

This invention relates to surveillance systems.

A previously proposed surveillance system detects abnormalities by the use of infra-red rays. When an abnormality is detected by such a surveillance system, the cause of the abnormality is not revealed unless someone goes to the site of the abnormality. Another inconvenience with this surveillance system is that there is no residual proof of a detected abnormality.

To overcome those inconveniences, a surveillance system using a television camera and a monitoring apparatus has been proposed. Such a system requires a supervising person to survey its operation. Further, if such a system uses a long-time playing video tape recorder (VTR), the VTR records only at intervals so that it may not record an important scene. Further, since abnormalities rarely happen, an abnormality may occur when the camera-VTR system is out of order and does not operate.

According to a first aspect of the present invention there is provided a surveillance system comprising:

image pick-up means;

image processing means connected to the image pick-up means for detecting a scene change represented by a change of a video signal obtained from the image pick-up means;

alarm means connected to the image processing means for generating an alarm signal in response to detection of a scene change; and

self-test means including a noise signal generator and means for superimposing a noise signal generated by the noise signal generator on the video signal to be supplied to the image processing means as quasi-scene change information.

According to a second aspect of the present invention there is provided a surveillance apparatus having self-test functions, the apparatus comprising an image pick-up device, an image processing device connected to the image pick-up device for detecting a scene change in video signals obtained from the image pick-up device, an alarm device connected to the image processing device for generating alarm signals upon detection of a scene change, and a self-test device

including a source of noise signals which are superimposed on the video signals to be supplied to the image processing means as quasi-scene change information.

A preferred embodiment of the present invention described in detail hereinbelow provides a surveillance system which is capable of removing the above-mentioned defects of the previously proposed system and, in particular, ensures proper or complete operation thereof.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which like references designate like items throughout, and in which:

Figure 1 is a block diagram schematically showing the circuit configuration of a surveillance system according to a preferred embodiment of the present invention;

Figure 2 is a diagram showing a control panel of the system of Figure 1;

Figures 3A, 3B and 3C are waveform diagrams for explaining how to set a threshold value level;

Figure 4 is a flow chart showing a test operation of the system of Figure 1;

Figure 5 is a flow chart showing a power supply control function in a manual mode; and

Figure 6 is a flow chart showing a power supply control function in an auto scan mode.

Figure 1 shows a surveillance system including a television (TV) camera 1 which outputs a video signal Sv through a line lv to a switching circuit 11 in a switch section 10. A microphone 2 is attached to the television camera 1. A signal Ss (a direct current (DC) signal) detected and outputted from a known sensor 3 using infra-red rays or the like is superimposed on an audio signal S_A outputted from the microphone 2 by a superimposing circuit 4. An output signal from the superimposing circuit 4 is supplied to the switch section 10 through a line la. In the switch section 10, the audio signal S_A from the microphone 3 is supplied to a switching circuit 12 and the DC detected signal Ss is supplied to an alarm input terminal of a central processing unit (CPU) 13.

Figure 1 shows only one set of sensors including the TV camera 1,

the microphone 2 and the sensor 3, for one channel. However, eight such sets are provided, one for each of eight channels, the sets being connected to the switch section 10 in the same manner as described above. Therefore, the switching circuit 11 is supplied in parallel with video signals Sv delivered from eight respective TV cameras 1 placed at different locations, the switching circuit 12 is supplied in parallel with audio signals S_A delivered from eight respective microphones 2, and the CPU 13 is supplied in parallel at its alarm input terminal with detecting signals Ss delivered from eight respective sensors 3.

Changing over of the switching circuits 11 and 12 is controlled by the CPU 13 according to operation by a user of a control panel 5 shown in more detail in Figure 2. If one of a set of channel selecting switches 71 to 78 on the control panel 5 is selectively pressed, the switching circuits 11 and 12 are manually changed over (switched) to a selected channel. If an automatic scanning switch 51 on the control panel 5 is pressed, the switching circuits 11 and 12 are sequentially changed over (switched) to different channels with a period set by sliding a scan speed setting lever 52 (e.g. 1 to 60 seconds). Selection of the channels that are to be sequentially changed over or switched (auto scan channels) is effected as follows. First, the auto scan switch 51 is left in a depressed state, in which switching portions of the respective channel selecting switches 71 to 78 are repeatedly lit and extinguished (blink). Then, the channel selecting switches 71 to 78 for those channels which are to be sequentially changed over (switched) are pressed in sequence, whereupon the switching portions thereof are illuminated. After this, the auto scan switch 51 is released from the depressed state, whereby the or each channel corresponding to an illuminated channel selecting switch is selected as an auto scan monitor channel.

It is not possible to select a channel whose function is set to an OFF state by a function selecting switch, as will be described later.

Referring again to Figure 1, the video signal Sv outputted from the switching circuit 11 is supplied to an adder circuit 14. The adder circuit 14 is supplied with character signals, representative of date, time, and channel, which are generated by a character signal

generator 15 under the control of the CPU 13, so that these character signals are added to the video signal Sv. Then, the composite video signal Sv including the character signals is supplied through a gate circuit 16 to a fixed terminal A of a change-over switch or circuit 17. Another fixed terminal B of the change-over switch 17 is supplied with a video signal Sv' from an external video signal input terminal 18V. One of the video signals Sv and Sv' selected by the change-over switch 17 is supplied to a video signal output terminal 20V through an amplifier 19.

The audio signal S_A outputted from the switching circuit 12 is supplied to a fixed terminal A of a change-over switch or circuit 21. An audio signal S_A' from an external audio signal input terminal 18A is supplied to another fixed terminal B of the change-over switch 21. One of the audio signals S_A and S_A' from the change-over switch 21 is supplied to an audio signal output terminal 20A through an amplifier 22. The video signal and audio signal outputted from the amplifiers 19 and 22, respectively, are also supplied to a monitoring apparatus 6.

Changing over (switching) of the change-over switches 17 and 21 is controlled by the CPU 13 according to operation by the user of the control panel 5. For example, the switches 17 and 21 are switched between their terminals A or B by pressing an external selection switch 53 shown in Figure 2. When the switches 17 and 21 are connected to their respective terminals A, an image reproduced from the video signal Sv is displayed on the screen of the monitoring apparatus 6 and sound from the audio signal S_A is generated by a loudspeaker of the monitoring apparatus 6. On the other hand, when the switches 17 and 21 are connected to their respective terminals B, an image reproduced from the video signal Sv' is displayed on the screen of the monitoring apparatus 6 and sound from the audio signal S_A' is generated by the loudspeaker of the monitoring apparatus 6.

The video signal Sv from each of the eight TV cameras is supplied through an adder circuit 23 to a digitiser circuit 31 and a synchronising signal separating circuit 32 in an image processing section or circuit 30. A digital output video signal Sv_2 produced by the digitiser circuit 31 is supplied to a switching circuit 33, and a synchronising signal Ssync separated from the video signal Sv by the

synchronising signal separating circuit 32 is supplied to a switching circuit 34. Switching of the switching circuits 33 and 34 is controlled by a CPU 35.

Among the eight channels, those channels which are selected to be sequentially changed over are defined as sensing channels, which means a channel in which a scene change can be detected by selecting a PRINT or ALARM functional mode or function. Selection of the function for each channel is effected by function selecting sliding switches 91 to 98 arranged on the control panel 5 as shown in Figure 2. The switches 91 to 98 enable selection of the PRINT function, the ALARM function, a MONITOR function or the above-mentioned OFF function. Selection of the PRINT function causes an alarm to be generated and the image from the channel in question to be printed out when a change in a scene is detected by the image processing section 30. Selection of the ALARM function causes an alarm to be generated when a change in a scene is detected by the image processing section 30. When the MONITOR function is selected, the image processing section 30 does not detect changes in a scene as mentioned above, so that neither generation of an alarm nor printing out of an image of the channel in question takes place. The changing over of the switching circuits 33 and 34 is effected with a predetermined period, e.g. 1/30 to 1/60 of a second.

The video signal Sv_2 from the switching circuit 33 is supplied to a serial-to-parallel converting circuit 36 comprising, for example, a shift register. The synchronising signal Ssync from the switching circuit 34 is supplied to an address comparator 37 in which a location address is generated from the synchronising signal Ssync and then compared with an assigned location address supplied to the address comparator 37 from the CPU 35. When the location address coincides with the assigned location address, a coincidence pulse P_O is supplied from the address comparator 37 to the converting circuit 36 to halt a shifting operation effected by the converting circuit 36, and data stored in the shift register thereby is written into a random access memory (RAM) 38 at a predetermined address as parallel data, under the control of the CPU 35. The assigned location address from the CPU 35 is sequentially changed so as to write the data into the RAM 38. Reference data corresponding to the video signal Sv_2 when no change is detected in a scene is previously stored in the RAM 38.

The operation described above is effected for each of the sensing channels. For each of the sensing channels, the CPU 35 compares the reference data with current data which is sequentially written into the RAM 38 afterwards. If a change of more than a predetermined amount is detected, a scene change alarm output signal S_{AL} is delivered from the CPU 35. The scene change alarm output signal S_{AL} may, for example, be a 4-bit signal comprising three bits of channel data and one bit of alarm data. The CPU 35 is operated by a program stored in a read only memory (ROM) 39.

The alarm signal S_{AL} from the CPU 35 is supplied to an alarm input terminal of the CPU 13. When the CPU 13 is supplied with the alarm output signal S_{AL}, the CPU 13 delivers a signal Sc which drives an alarm generating circuit 24 comprising a buzzer or a lamp. The signal Sc is also supplied to an external alarm output terminal 25.

When the alarm output signal S_{AL} is supplied to the CPU 13, the switching circuits 11 and 12 are changed over to the corresponding channel by the CPU 13, and the change-over switches 17 and 21 are connected to their respective terminals A by the CPU 13 if they previously were connected to their respective terminals B. Then, the monitoring apparatus 6 displays on its screen an image reproduced from the image signal Sv supplied from the corresponding channel. Further, a printer trigger signal S_{TR} is generated by the CPU 13 and supplied through a trigger control circuit 26 to a CPU 41 which is provided in a printer section 40. When the CPU 41 is supplied with the trigger signal S_{TR}, a memory control circuit 42 of the printer section 40 is controlled by the CPU 41 and the signal Sv from the corresponding channel is converted into a digital signal by an analogue-to-digital (A/D) converter 43 and signals corresponding to one field of the converted signal Sv are then written into a video memory 44 under the control of the memory control circuit 42. Then, data is sequentially read from the video memory 44, under the control of the memory control circuit 42, and supplied to a printer head 45. At the same time, a printer motor 46 is driven to print an image of the corresponding channel.

The video memory 44 comprises storage with a capacity of, for example, four field memories. Therefore, even if four trigger signals

S_{TR} are successively supplied to the CPU 41, one field of the respective video signals Sv of the corresponding channels can be written into the video memory 44. When four field memories are all in use and a current printing operation is not terminated, a printer busy signal S_{PB} is generated by the CPU 41 and then supplied to the trigger control circuit 26 to inhibit the circuit so as not to supply the trigger signal S_{TR} therefrom to the CPU 41.

The above description assumes that the CPU 13 is supplied with the alarm output signal S_{AL}. However, the same operation is effected when a change in a scene is detected by the detected signal Ss.

In order that the image processing section 30 will operate correctly, it is necessary to set correctly a threshold value level E_0 for the digitiser circuit 31 in the image processing section 30 corresponding to a value of the level of the video signal Sv delivered from the TV camera 1 of each channel. When the video signal Sv is at a level indicated by a solid line in Figure 3A, the threshold value level E_0 may be set to an approximately central value of a range of the video signal Sv, as shown by a broken line in Figure 3A. Then, the video signal Sv_2 delivered from the digitiser circuit 31 has a waveform as shown in Figure 2B. The threshold value level E_0 is set for each of the channels, as is hereinafter explained.

First, a SETTING mode is selected by means of a sliding switch 54 on the control panel 5 shown in Figure 2. At this time, the change-over switches or circuits 17 and 21 are connected to their respective terminals A under the control of the CPU 13 and the monitoring apparatus 6 is supplied with the video signal Sv through the gate circuit 16 to display an image reproduced from this video signal Sv on the screen thereof.

Next, a channel for which the threshold value level E_0 is set is selected by pressing one of the channel selecting switches 71 to 78. At this time, the switching circuits 11 and 12 in the switch section 10 and the switching circuits 33 and 34 in the image processing section 30 are respectively changed over to the selected channel, under the control of the CPU 13.

In the operation described above, the gate circuit 16 is controlled by the CPU 13 so as to gate the video signal Sv from the

adder circuit 14 by use of the digitised video signal Sv_2 derived from the switching circuit 33. For example, when the apparatus is operating in a normal condition, the gate circuit 16 is controlled such that it allows the video signal Sv delivered from the adder circuit 14 to pass therethrough unmodified. Therefore, when the video signal Vs from the adder circuit 14 has a waveform as indicated by the solid line in Figure 3A, while the video signal Sv_2 from the switching circuit 33 has a waveform as shown in Figure 3B, the video signal Sv having a waveform as shown in Figure 3C is outputted from the gate circuit 16 and supplied to the monitoring apparatus 6 which displays an image reproduced from such video signal Sv on the screen thereof.

Next, if the threshold value level E_0 for each channel is adjusted by rotating knobs 81 to 88 arranged on the control panel 5, for setting the threshold value E_0 for corresponding channels, the video signal Sv_2 is changed, which causes a change in the video signal Sv from the gate circuit 16, and thereby an image on the screen of the monitoring apparatus 6 also is changed. Thus, the operator adjusts the threshold value level E_0, as shown by the broken line in Figure 3A, while monitoring the image on the screen of the monitoring apparatus 6. When the threshold value level E_0 is adjusted as shown in Figure 3A, the image on the screen of the monitoring apparatus 6 is such that a bright portion and a dark portion each substantially occupy half of the entire image.

Then, if an OPERATION mode is selected by means of the sliding switch 54, the apparatus returns to the operating condition.

As described above, if a change is detected in an image delivered from a sensing channel, the alarm signal S_{AL} is outputted from the image processing section 30 to generate an alarm from the alarm generating circuit 24, or the image from that channel is printed out. However, it is necessary to check or test whether the image processing section 30 is operating normally. According to the present embodiment, the surveillance apparatus is so constructed that the image processing section 30 can be manually or automatically checked.

A description of how the image processing section 30 is manually checked will now be given. First, a test switch 55 on the control panel 5 is pressed, whereby a noise generating circuit 27 is activated

by the CPU 13 and noise (a noise signal) S_N generated thereby is added by the adder circuit 23 to the video signal Sv delivered from the TV camera 1 of each of the respective eight channels, and then the output signal from the adder circuit 23 is supplied to the digitiser circuit 31. Further, the switching circuits 11 and 12 in the switch section 10 and the switching circuits 33 and 34 in the image processing section 30 are respectively changed over, with a predetermined cyclic period, sequentially from one of the sensing channels to another, in synchronism.

Adding the noise S_N to the video signal Sv results in a quasi-change in a scene. Therefore, if the image processing section 30 is operating correctly or normally, the alarm output signal S_{AL} should be outputted from the CPU 35, as described above. If, however, the image processing section 30 is not operating correctly, the alarm output signal S_{AL} is not outputted from the CPU 35.

Further, when the test switch 55 on the control panel 5 is pressed, the change-over switches 17 and 21 are connected to their respective terminals A under the control of the CPU 13. Also, every time each of the sensing channels is sequentially changed over, the CPU 13 supplies the printer trigger signal S_{TR} through the trigger control circuit 28 to the CPU 41 of the printer section 40, and the character signal generating circuit 15 generates, in addition to character signals representative of the date, time and channel, character signals representative of "OK" when the alarm signal S_{AL} is outputted, or character signals representative of "NG" when the alarm signal S_{AL} is not outputted. The character signals are added to the video signal Sv by the adder circuit 14. Therefore, corresponding to each of the sensing channels, the monitoring apparatus 6 displays an image with "OK" or "NG" superimposed thereon, and the printer section 40 prints the image with "OK" or "NG" superimposed thereon. When the above-mentioned checking operation is terminated for all of the sensing channels, the system returns to the normal operating condition.

If "NG" is displayed, the image processing section 30 is not operating correctly for the corresponding channel, so that the threshold value level E_0 for this channel, applied to the digitiser circuit 31, has to be set again in the same manner as described above.

In the case of automatic testing, the same operation as performed in the above-described manual test is automatically effected at predetermined time intervals, for example every 10 days.

Figure 4 is a flow chart generally showing the operation effected by the embodiment of the present invention shown in Figure 1, including the above-mentioned manual and automatic tests. When the embodiment shown in Figure 1 is operated by a timer, it may be that the power supply is turned off at the time that the automatic test is about to start. In that event, the power supply is turned on before the automatic test starts and turned off again when the automatic test is completed, as shown in Figure 4.

Referring again to Figure 1, a power supply circuit 7 supplies required electrical power to the switch section 10, the image processing section 30 and the printer section 40. The TV cameras 1 in the eight channels are supplied with electrical power through a power supply control circuit 28 arranged in the switch section 10. The power supply control circuit 28 is controlled by the CPU 13 to control the supply of power to the TV cameras 1 in the eight channels as follows. When the power supply is turned on, all the TV cameras 1 in the eight channels are supplied with electrical power. Then, it is determined whether or not there is a channel in which the TV camera is not connected, by checking for the presence of a synchronising signal. Next, electrical power is supplied to the TV cameras 1 of all the channels which are not left in the OFF mode by the function selecting switches 91 and 98 and have a TV camera 1 connected therewith, and simultaneously the channel having the smallest or lowest number is determined as the selected channel (manual mode). If none of the channel selecting switches 71 to 78 is depressed within a predetermined time period (for example 30 seconds) in this state, the power supply is halted for all of the TV cameras 1 except for the TV cameras of the lowest-numbered channel and the sensing channels. On the other hand, if one of the channel selecting switches 71 to 78 is depressed within the predetermined time period, the measured time is cleared and measurement of the time is started again from the time at which the switch was depressed. If none of the channel selecting switches 71 to 78 is depressed within a predetermined time period (for example 30 seconds) after depression of the channel selecting switches

71 to 78, the power supply is halted for all of the TV cameras 1 except for the TV cameras of the selected channels and the sensing channels. If one of the channel selecting switches 71 to 78 is depressed after the predetermined time period has elapsed, electrical power is again supplied to the TV cameras 1 of all the channels which are not left in the OFF mode by the function selecting switches 91 to 98 and have a TV camera 1 connected therewith, and an operation similar to that mentioned above is carried out. Figure 5 is a flow chart showing the above-described operation.

When the auto scan switch 51 is pressed (the auto scan mode), the power supply is halted for the TV cameras 1 except for those in the auto scan channel and sensing channels. Figure 6 is a flow chart showing this operation.

The monitoring apparatus 6 is supplied with electrical power from the power supply control circuit 28.

Referring again to Figure 2, the control panel 5 has a power supply switch 56, a switch 57 for feeding the printer section 40 with paper on which images are printed, a switch 58 for printing an image reproduced from the video signal then supplied to the printer section 40, a switch 59 for printing an image reproduced from the video signal stored in the video memory 44, a switch 60 for turning on and off the automatic printing function at the time when the alarm signal S_{AL} is outputted or the like, a switch 61 for turning on and off the timer operation, a switch 62 for turning on and off the alarm generating circuit 24, a light emitting diode 63 which constitutes the alarm generating circuit 24, a lever 64 for adjusting, for example, a volume of the buzzer which also constitutes the alarm generating circuit 24, a group 65 of switches for determining a range in which changes in scene are detected, and a group 66 of switches for setting the time of the timer.

As described above, the present embodiment automatically checks at predetermined intervals, for example every 10 days, whether or not the image processing section 30 is operating normally, so that proper operation of the image processing section 30 can be ensured, rendering it possible to provide a surveillance system with high accuracy. Further, while the image processing section 30 is thus automatically checked, the printer section 40 is in operating condition. Therefore,

a check is made simultaneously as to whether or not the printer section 40 is operating normally, which is another advantage of the embodiment.

Further, according to the present embodiment, a user can freely set the change-over cyclic period of the switching circuits 11 and 12 of the switch section 10 by means of an operating knob 52 on the control panel 5, independently of the change-over cyclic period of the switching circuits 33 and 34 of the image processing section 30, which gives facility in operation to users. When the alarm signal S_{AL} is outputted from the image processing section 30, the switching circuits 11 and 12 are respectively changed over to a corresponding channel, and the monitoring apparatus 6 displays an image from this channel on its screen, so that no problem will occur as a result of abnormal conditions of these switches.

Furthermore, according to the present embodiment, the electrical power supplied to the TV cameras 1 is controlled by the power supply control circuit 28 so as to halt the power supply to unused TV cameras, which results in largely reducing the power consumption as well as prolonging the effective life of the TV cameras 1, and particularly the image pick-up devices arranged therein.

Still further, in the manual mode, all the TV cameras 1 are supplied with electrical power for a predetermined period of time, for example 30 seconds. Therefore, if one of the other channels is selected within this predetermined period of time, the image on the screen can be prevented from deterioration due to initial unstable conditions and so on, whereby users will not suffer the unpleasant viewing of initial conditions.

CLAIMS

1. A surveillance system comprising:

image pick-up means (1);

image processing means (30) connected to the image pick-up means (1) for detecting a scene change represented by a change of a video signal obtained from the image pick-up means (1);

alarm means (13, 24) connected to the image processing means (30) for generating an alarm signal in response to detection of a scene change; and

self-test means including a noise signal generator (27) and means (23) for superimposing a noise signal generated by the noise signal generator (27) on the video signal to be supplied to the image processing means (30) as quasi-scene change information.

2. A surveillance system according to claim 1, wherein the self-test means includes timer means and means for controlling the superimposing of the noise signal on the video signal at predetermined times in response to operation of the timer means.

3. A surveillance system according to claim 1 or claim 2, comprising a printing system (40) operative to print an image of the video signal in response to detection of a scene change by the image processing means (30).

4. A surveillance system according to claim 1, claim 2 or claim 3, wherein the image pick-up means (1) includes a plurality of TV cameras and switching means (10) is provided for cyclically selecting different ones of the cameras to supply video signals to the image processing means (30) at predetermined times.

5. A surveillance system according to claim 4, which is operative to superimpose the noise signal on the video signal of each of the TV cameras (1), and wherein the switching means (10) includes means to select cyclically one of the noise-superimposed video signals.

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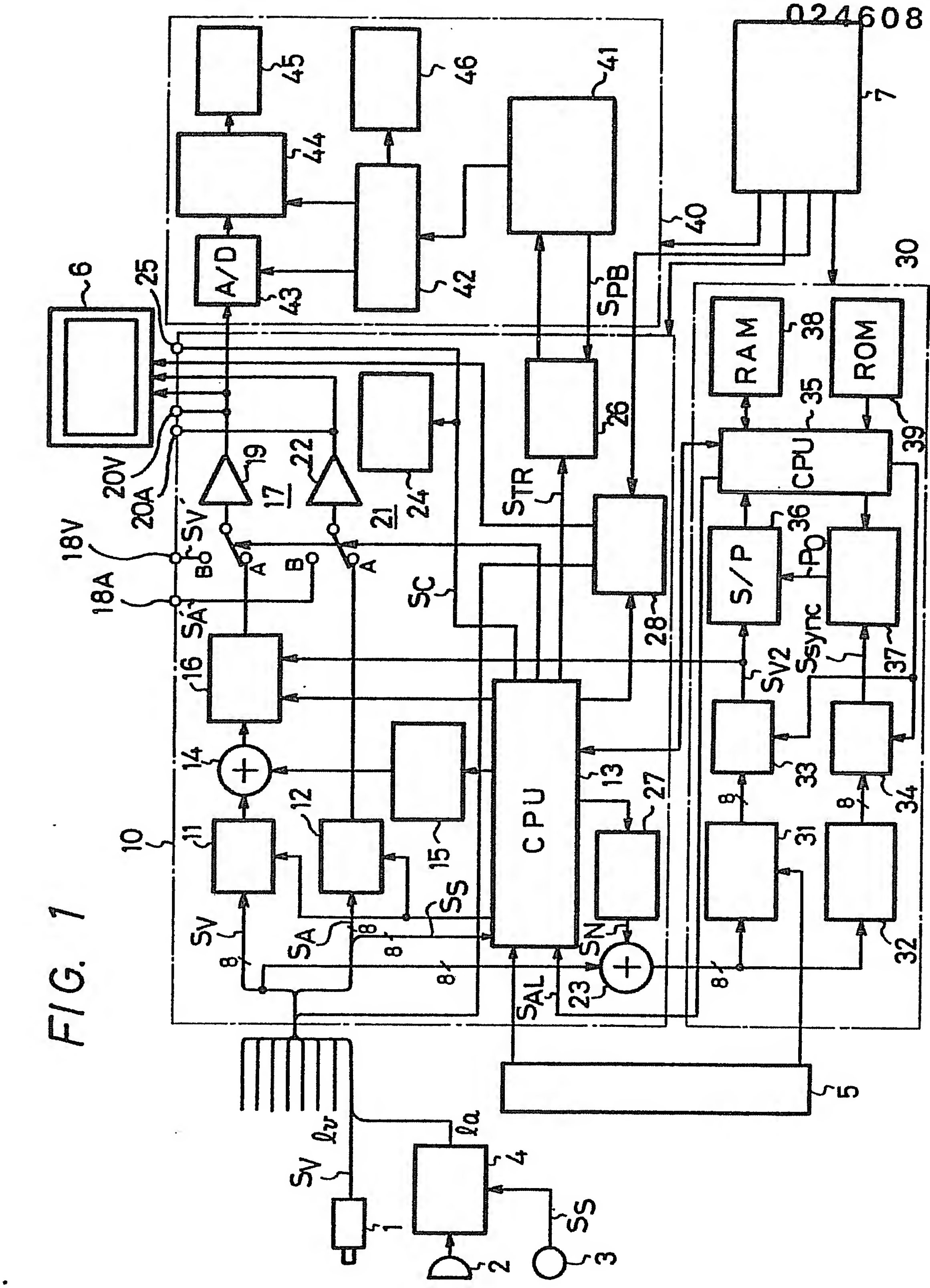

FIG. 1

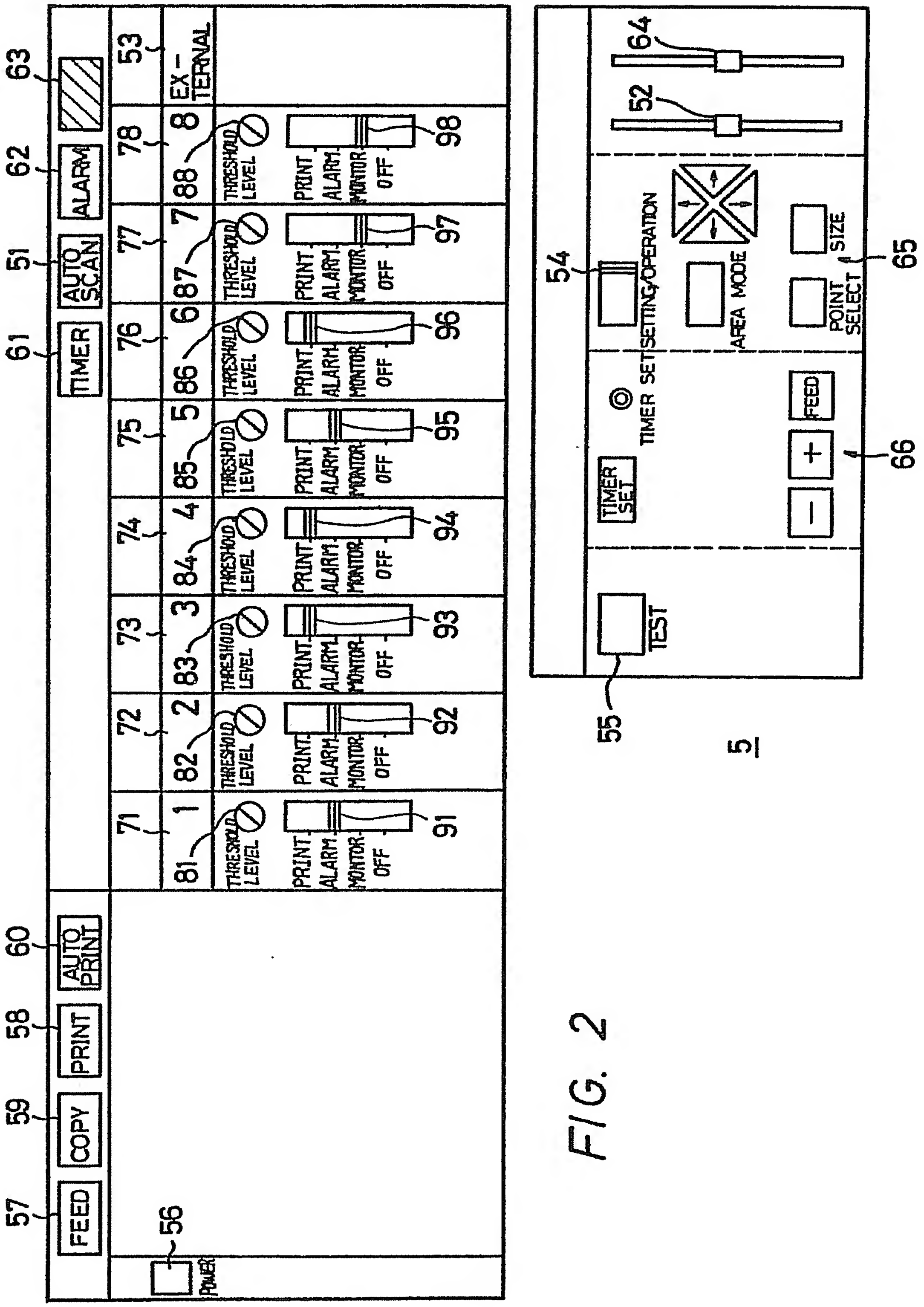
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FIG. 2

FIG. 3A

FIG. 3B

FIG. 3C

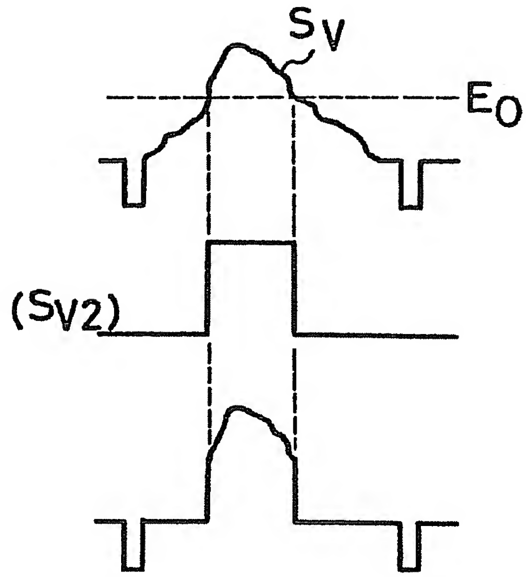


FIG. 6

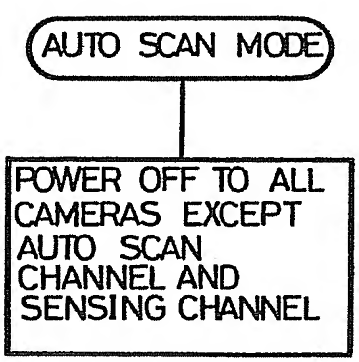
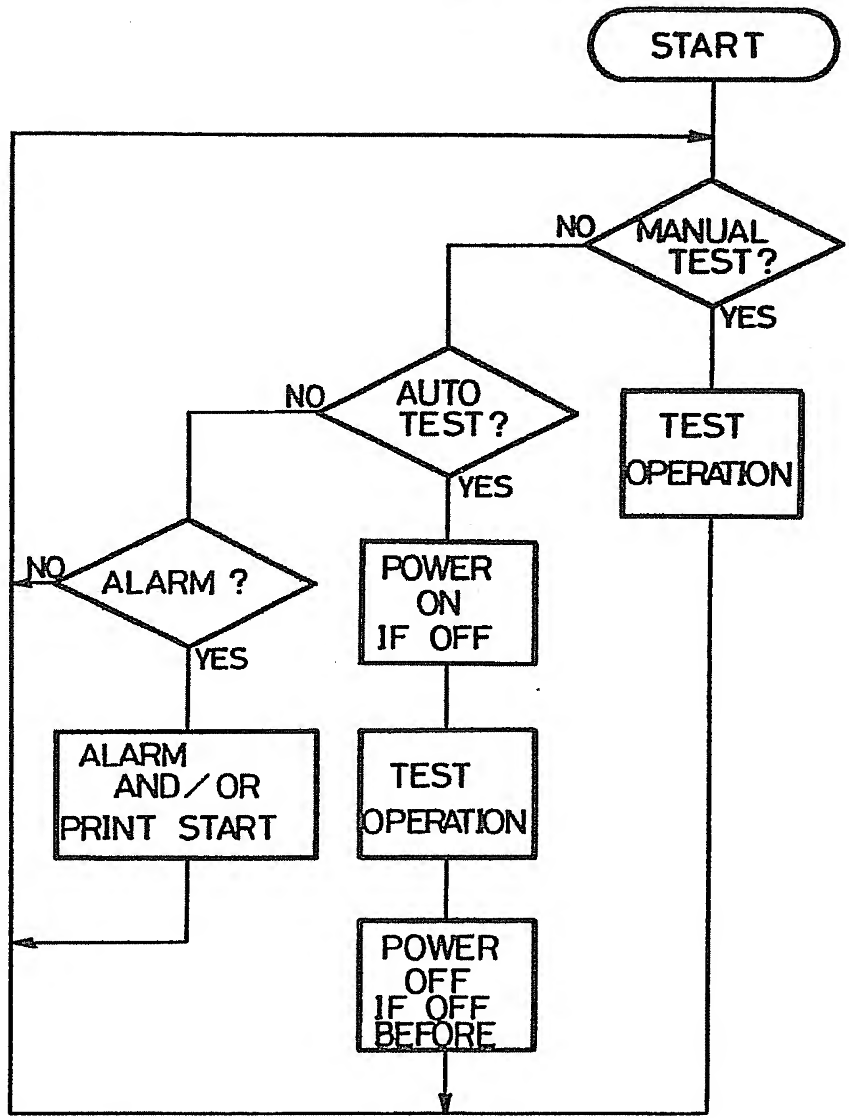


FIG. 4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NO
YES
TEST OPERATION
AUTO TEST?
NO
YES
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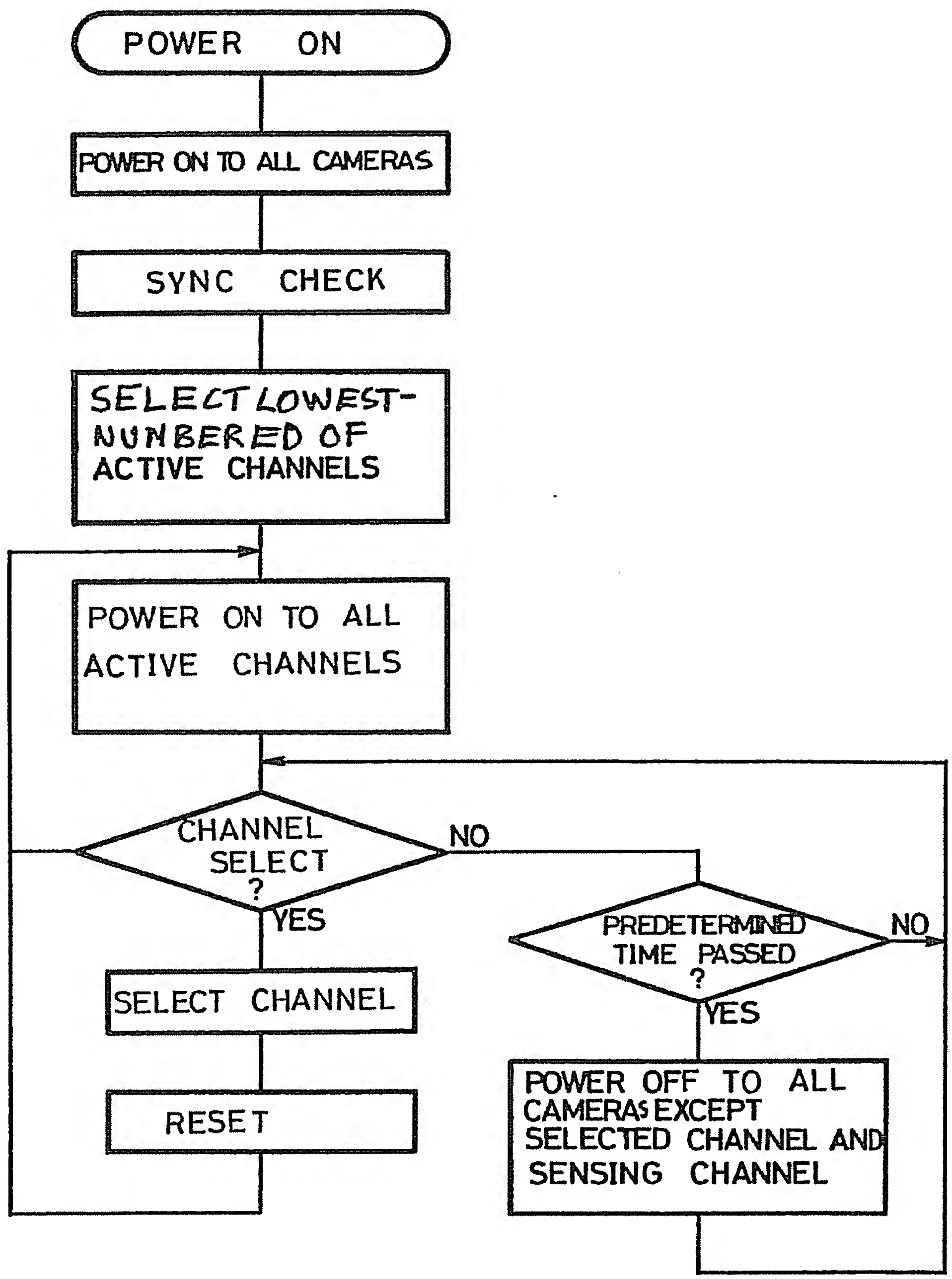
TEST OPERATION
POWER OFF IF OFF BEFORE
ALARM ?
NO
YES
ALARM AND/OR PRINT START

FIG. 5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CHANNEL SELECT ?
NO
YES
SELECT CHANNEL
RESET
PREDETERMINED TIME PASSED ?
NO
YES
POWER OFF TO ALL CAMERAS EXCEPT SELECTED CHANNEL AND SENSING CHANNEL